

## UnESS Concept Study Questions and Answers

Below are answers to questions from Experimenters involved in the UnESS Concept Study for NASA AO 99-OES-02.

**Changes to this file will be highlighted as follows:**

**Questions/changes added on 1/17/01 are in yellow highlight.**

**Questions/changes added on 2/02/01 are in green highlight.**

The questions are sorted in the following groupings:

- General Concept Study Questions
  - Additional requirements since AO release
  - Financial questions
  - Site Visit questions
- ISS Questions
  - Express Pallet questions
  - WOLF questions

### **General Concept Study Questions**

Q1: What environmental document should we use to complete the UnESS study?

A1: **The GENERAL ENVIRONMENTAL VERIFICATION SPECIFICATION FOR STS & ELV PAYLOADS, SUBSYSTEMS, AND COMPONENTS [GEVS-SE REV A (JUNE 1996)] document. This document is available at the UnESS Library (<http://uness.larc.nasa.gov/uness/unesslib.html>)**

Q2: We have identified several potential sponsors (i.e. DOD) that would be interested in our technology and/or scientific results. We wanted to check with your office to make sure that adding a DoD sponsor to our program was acceptable from your point of view.

A2: **You are permitted to partner with other organizations, and may be from other universities, industry, nonprofit institutions, other Government agencies, or foreign organizations. Please see conditions in section 3.1 of the UnESS AO under General Project Requirements, constraints, and Guidelines.**

Q3: We could use some help in regard to working with a European collaborator. I have not been able to find the information in the UnESS library on the required documents for teaming with international

organizations. Perhaps more importantly, in trying to set up this agreement, our colleague has requested some technical information on the satellite downlink. We believe that we need an export license to release this information to him, but it doesn't seem feasible to arrange this unless (or until) our project is selected as a flight program. Can you provide some guidance on how to proceed?

A3: From the UnESS website homepage, click on the 'UnESS Library' link, and go to item 47: "Elements to be Included in Arrangements between U.S. Principal Investigators and Cooperating Foreign Parties Under the ESSP Program". It is the responsibility of the PI not to release ITAR sensitive information, without first establishing an international agreement through NASA HQ/Code I. See the UnESS Project for contacts.

Q4: One of the appendices required in our CSR is a compliance matrix. It occurred to me that all 5 teams are working to the same guidelines, so perhaps the UnESS office could put together a matrix with the requirements and guideline page numbers. Then each of the teams could fill it in with the section numbers from our reports. If you really intend to use these during your evaluation, this should give you a more uniform and more useable product. What do you think?

A4: The UnESS project has put a compliance matrix together and placed it on the UnESS project website on Thursday, 1/18/01 under the link: **Concept Study Submittal Information at:** [http://www.wff.nasa.gov/~code850/pages/submittal\\_info.html](http://www.wff.nasa.gov/~code850/pages/submittal_info.html)  
The purpose of the compliance matrix is to help the teams ensure that all the requirements are included in the concept study.

Q5: What is the difference between "Endorsements," which are listed with the cover page and table of contents, and "Letters of Endorsement" required in the appendices?

A5: The endorsements up front are the signatures of the participants "PI, Co-I, lead team members, contributors and non-US participants." They are the ones who will be doing the work or leading the work. Generally, a team member does not have the authority to commit money or personnel from the organization.  
Therefore, a letter of endorsement from their organization is required from someone who has the authority to commit the organization to such an activity. Without this letter, NASA cannot make sure the organization is committed to participating on the project. This could present a risk to the project if the participant has not gotten an approval from their boss.

## **Endorsements:**

From the Concept Study Guidelines:

From pg.4

### **B ENDORSEMENTS**

Include endorsements for all co-investigators, lead team members, contributors, and non-U.S. participants. NASA will not count these pages against the page limit. Include with the endorsements the named individual's signature, full name, address with zip code, telephone and fax numbers, and electronic mail address. You must document that the institutions and/or governments involved endorse any participation by non-U.S. individuals and/or institutions as team members or contributors to your investigation. NASA requires institutional endorsements for all contributions. If you require government support then you need a government endorsement specifying the support that is to be provided (this includes Civil Service labor, government laboratory and testing facilities, and government spacecraft command and communications facilities, etc.). The letters of endorsement (to be included as Appendix B) must provide evidence that the non-U.S. institution and/or government officials are aware and supportive of your investigation and will pursue funding for the investigation if selected by NASA. You must submit such endorsements per the schedule in the AO and in compliance with the provisions of the AO's International Participation Section.

## **Letters of Endorsement:**

From the Concept Study Guidelines:

From pg. 19

Letters of Endorsement. Provide letters of endorsement from all organizations participating in and critical to the investigation. Make sure these letters of endorsement are signed by both the lead representative from each organization represented on the team, and by institutional and Government officials authorized to commit their organizations to participation in the planned investigation.

**Q6:** Would CDs for the electronic version of the proposal be acceptable?

**A6:** In addition to floppy disks, or zip drives, CDs with your concept study are acceptable. Please provide a copy of your study on disk, Zip or CD with your submittal of the 25 hard copies of the concept study.

Q7: With regard to the Concept Definition Study guidelines viz., "NASA has limited the number of pages for the main sections of the report to 125 pages, with a maximum of seven foldout pages (28 x 43 cm; i.e., 11 x 17 inches). Table 1 identifies the sections to which these page limits apply. Any pages in excess of these limits may be discarded without review."

Does this mean 125 pages including 7 foldouts, or 125 pages + 7 foldouts. Given the ever-increasing review/risk/IV&V requirements and the ambiguity of the above phraseology I would suggest that the latter meaning is in order, but wouldn't want the proposal to be rejected for want of asking for clarification.

A7: Given the introduction of new NASA requirements since the release of the AO, NASA will permit 125 pages plus 7 foldouts for a total of 132 pages.

Q8: In the experience and commitment of key personnel section of the CSR guidelines, a reference point of contact is required. Similarly, in Appendix G, relevant experience and past performance, a point of contact is requested. Could you clarify what you want for these? Do you need a customer or is someone within our organizations OK?

A8: This is just like a job reference on an application. It is someone who can speak to the qualifications and experience of a person or the team for doing the proposed work. It does not have to be a member of any particular organization.

Q9: Is the compliance matrix labeled "Table 3. Compliance Matrix" the compliance matrix that is listed in the CSR guidelines (appendix K.L page 20 of CSR guidelines). The CSR guideline says to include where in the CSR guidelines (page and section) the requirement is listed. This is not reflected in the Compliance Matrix on the web at [http://www.wff.nasa.gov/~code850/pages/submittal\\_info.html](http://www.wff.nasa.gov/~code850/pages/submittal_info.html) So is the compliance matrix listed on the web the required compliance matrix listed in section L, element K (on page 20 of CSR guidelines)? (i.e., is this the only Compliance Matrix required in the CSR?)

A9: No, they are two different items. The compliance matrix listed on the UnESS web site is intended to serve as a check off list to make sure all required Concept Study items have been included. To try to eliminate the confusion, the web site Compliance Matrix has been relabeled 'Compliance Table'. The Compliance Matrix listed in the Concept Study Guidelines still has to be filled out according to the directions in the Concept Study Guidelines. See question 10 in this section for more information.

A10: In the Compliance Matrix on the UnESS Web site, there is no item for Appendix L part L Office of Equal Opportunity Programs Minority University Research and Education Funding Accomplishments. We used this funding source during the CS Phase and are therefore required to produce this information (see CSR guidelines page 20 section L). Should this be included in the Compliance Matrix?

A10: This was inadvertently left out of the Compliance Matrix (now Compliance Table) that is on the UnESS web site. This has been changed. **If you received this funding as part of your Concept Study Proposal, this Appendix must be included.** See question 9 of this section for more information.

Q11: Do the Investigative Summary Forms I and II, required in Section 1.0 of the Concept Study (see Guidelines for Concept Study Report Preparation page 3) count against the page count for this section?

A11: No, since these forms were required in the AO proposal (see page C-3) and it was stated that these forms do not count against the page count, we will carry that over to the Concept Study Proposal as well.

## Additional Requirements since AO release:

Q1: What new or additional review requirements are required for UnESS ?

A1: There have been additional review requirements made by NASA since the AO was released. These additional requirements are geared toward enhancing the mission success of NASA flight projects. They include increased peer and system level reviews, a Red Team Review and Software Independent Verification and Validation (IV&V) review. The scope of these reviews are evolving, and the specific requirements will be tailored after down selection, when the UnESS project can review the specific requirements of the missions selected for further study/definition.

Q2: Are the new requirements listed in the mission assurance documents (for additional reviews, Red Team Reviews, Software IV&V, and a reserves requirement of 20%) over and above the UnESS \$15M cost cap, or must they be absorbed within the cost cap?

A2: The new requirements are over and above the \$15M UnESS cost cap. Since these requirements (Increased peer and system level reviews, Red Team Reviews, Software IV&V, and adequate funding reserves(20%)) were introduced after the AO release, they are requirements the UnESS project will pay for over and above the \$15M cap. Thus, they are considered **Out of Scope Costs**.

The UnESS project has attempted to estimate the costs of these additional requirements. Since we have no insight into each study, we have estimated these costs, and after down selection, we will work with each team **to refine these costs**.

Each team should list these **out of scope** costs in your budget summary:

- |  |         |
|--|---------|
| 1. Additional Reviews/Red Team Reviews | \$0.5 M |
| 2. Additional Reserves(20%)/Testing    | \$1.0 M |
| 3. Software IV&V                       | \$0.6 M |

These out of scope costs are summarized on chart 16 in the presentation titled "UnESS Reviews, Risk Management, Red Team Process"

found at:

[http://www.wff.nasa.gov/~code850/pages/uness\\_mission\\_assurance.html](http://www.wff.nasa.gov/~code850/pages/uness_mission_assurance.html)

Q3: What percent contingency should I hold in my project budget?

A3: Your project should carry 20% in contingency on development costs (Phase B/C/D). Further, increased system level testing maybe required by NASA. Since these requirements of adequate reserves/testing were introduced after the AO was released by the NASA, show these budget requirements as an out-of-scope line entry, as shown above in Question #2:

Additional Reserves (20%)/Testing	\$1.0 M
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Regarding launch date, you should apportion the contingency for the launch readiness date you plan for. After selection, should the launch date change, the UnESS project will work with each project to update contingency accordingly.

Q3 Follow up on Contingency:

Before the out of scope costs were provided, we were advised to carry at least 10% contingency. This calculates to:  
 $\$15\text{M} \times 10\% = \$1.5\text{M}$  >  $\$15\text{M} - \$1.5\text{M} = \$13.5\text{M}$  available.

Given the out of scope funds, and the directive about 20% contingency, it calculates to:  
 $\$17.1\text{M} \times 20\% = \sim \$3.4\text{M}$  >  $\$17.1\text{M} - \$3.4\text{M} = \$13.7\text{M}$  available.

If we cover Red Team and IV&V at \$1.1M out of the \$13.7M, it leaves \$12.6M to work with -- almost a million less than we originally planned.

Is this what you intended?

A3: NASA intends for the 20% contingency to provide adequate reserves, not create a bigger problem for the project. 20% Contingency (or Reserve) should only be carried on development costs (Phase B/C/D). For instance, do not carry contingency for operations costs.

**Latest Direction on the 20% Contingency (reserves):**

List the difference between your planned contingency and the new 20% contingency requirement (on development costs only) as the additional reserves required by your project. List this as an Out-of-Scope line at the bottom of your budget.

In this case, your project's out-of-scope reserves line item may be greater than the \$1.0M estimated and previously directed by the UnESS project in A3 above.

#### To calculate your Contingency:

Contingency (or reserve) when added to a resource, results in the maximum expected value for that resource. Percent contingency is the value of the contingency divided by the value of the resource less the contingency.

Margin is the difference between the maximum possible value of a resource (the physical limit or the agreed-to limit) and the maximum expected value for a resource. Percent margin for a resource is the available margin divided by its maximum expected value.

Example: the development costs for a project are estimated to be the following:

Original total cost:	\$15M
Less the concept study	- 300k
Less operations costs	- 700k
Development costs w/ contingency	\$14M

Say for instance, that the project was originally selected with 10% contingency of  $\$14M \times .10 = \$1.4M$

Thus, the development costs without contingency is \$12.6M

Given the new requirement of 20% contingency.

Multiply  $\$12.6 \times .2 = \$2.52M$ , giving a total

Development cost of  $\$12.6M + \$2.52M = \$15.2M$

Adding back the:

Concept study	300k
Operations cost	700k

Adding the out of scope items:

Additional Reviews	\$0.5 M
Software IV&V	\$0.6 M

Gives a total mission cost of \$17.3M

Example: A payload in the design phase has an estimated mass of 115 kg including a mass reserve of 15 kg. There is no other payload on the

ELV and the ELV provider plans to allot to you the full capability of the vehicle, if needed. The ELV capability is 200 kg. The mass reserve is  $15/100 = 15\%$  and the mass margin is 85 kg or  $85/115 = 74\%$ .

Example: The end-of-mission life capability of a spacecraft power system is 200 watts. Your instrument is expected to use 50 watts, including 20% contingency. You are allotted 75 watts by the satellite provider. Your reserve is 10 watts and your margin is 25 watts, or  $25/50 = 50\%$ .

Q4: How do we call out a risk management process? Could you point me in the direction of some documentation regarding the requirements of the Risk Management Review or Red Team Review?

A4: See the **Mission Assurance** link for related Risk management/Red Team documents, at the UnESS project website homepage at:

[http://www.wff.nasa.gov/~code850/pages/uness\\_mission\\_assurance.html](http://www.wff.nasa.gov/~code850/pages/uness_mission_assurance.html)

The Risk management process referred to at the Kick off meeting is still evolving in NASA. In addition to risk management activities your project would normally do to track risks and manage/retire them, the following *additional requirements not originally in the UnESS AO* are now required:

1. Additional Peer and System Level reviews (see page 6 of the UnESS Reviews, Risk Management, Red Team Process document) found at: [http://www.wff.nasa.gov/~code850/pages/uness\\_mission\\_assurance.html](http://www.wff.nasa.gov/~code850/pages/uness_mission_assurance.html)
2. A Red Team (or Risk management) review as part of the Pre-ship review. The criteria are enclosed in the UnESS Reviews, Risk Management, and Red Team Process document above. Further samples of other missions Red Team Charters are also found
3. Software Independent Verification and Validation (IV&V)
4. A review of project reserves to ensure adequate reserves at 20% and to ensure resources for adequate testing.

For more information on NASA's Red Team Criteria, and charters for other current projects see the UnESS website under the heading 'UnESS Mission Assurance Information'.

Q5: How do we show out of scope costs (additional requirements) in the mission budget profile?

A5: For the additional requirements presented at the UnESS kickoff meeting and contained in the Risk management process, show these costs as “out-of-scope costs” at the bottom of your Budget summary chart. See answer A2, from this section, above.

Q6: Also, regarding the tables you requested in the guideline change document. Do you want those as part of the report or as a separate document? I was assuming that we could just make sure those tables appear some where in our report, but closer reading makes me think you want a separate document.

A6: Please place the **Downselect Process Modification Document** as an Appendix. You can find the **Downselect Process Modification Document** at:

[http://www.wff.nasa.gov/~code850/pages/submittal\\_info.html](http://www.wff.nasa.gov/~code850/pages/submittal_info.html)

This document will not be counted against the page limit.

## **Financial Questions**

Q1: Do you intend to use a grant to continue our funding (assuming we are selected)? The extreme level of cost detail required in the CSR seems inconsistent with the more relaxed reporting requirements of the current grant.

A1: After down selection, teams going forward will be funded through a contract. The reporting requirements will be negotiated with the selected team in addition to a NASA form 533.

Q2: What kind of reporting requirements are required by the contract?

A2: A monthly assessment of performance, cost, and schedule. Also a NASA reporting form 533 is required. Further reporting will be negotiated based on selection with the winning teams.

Q3: I am trying to set up the budgets to feed into the tables for the proposal submission. I'd like your help on Table L-4. It asks for development elements by Recurring and non-recurring components. This might be appropriate for private companies but all of our costs are non-recurring. Please clarify what should be included.

A3: The difference between recurring and non-recurring costs is usually important only in commercial activities or DoD contracts. For a commercial entity, development costs (non-recurring costs) must be amortized over a period of time, while production costs (recurring costs) are expensed in the current period. DoD contracts are often funded from different sources: Congress allocates research and development funds

for the design of a new system, and then provides annual funding increments for production separately.

The distinction between recurring and non-recurring is also important for NASA as it helps us to determine what part of the cost of a project is for technical design and improvement of TRL, and what part is for production of hardware in a build-to-print mode. This is used in our risk management assessment of the project and as a sanity check on heritage claims. If a UnESS project is building a copy of an instrument or spacecraft bus that has already been designed for another project, then all of the costs, except for cost of modifications, would be considered recurring. On the other hand, if the project is creating a new instrument that has never been built before in that specific configuration, then all of the costs would be considered non-recurring. If the project is building multiple spacecraft (such as the ESSP GRACE project), then the design and building of the first of the two spacecraft would be considered non-recurring, while the cost of the second spacecraft would be considered production of an existing design, and therefore recurring cost.

The study team should make a "best effort" attempt to separate the costs by asking itself if the cost of a component/subsystem/system/etc. is a new design effort (non-recurring), or if it is production of an existing design (recurring) and categorize accordingly.

Q4: We are working on the budget and there are a lot of ways we could break things down. Looking at the AO things appeared to be wanted in fiscal year (FY) and that is how our original budget was done. Since our final award was not directly a consequence of our original budget that didn't seem to matter too much. Now we are not sure. One of us has found where we need to do a budget according to project phases but I am assuming we also need a budget with traditional years.

A4: The cost and budgetary data must be provided by government fiscal year. When cost and budget data is requested by phase and fiscal year, it should be provided that way also. Quick example:

Project cost by fiscal year:

FY01	FY02	FY03	FY04 ...
2.1M	5.6M	4.3M	1.3M

Project cost by phase and fiscal year:

	FY01	FY02	FY03	FY04 ...	
Phase 1	0.8M				(Nov00 to Mar01)
Phase 2	1.3M	5.6M	3.5M		(Apr01 to Jun03)
Phase 3			0.8M	1.3M	(Jul03 to ...)
etc.					

In other words, phases do not have to end or begin at the start of a fiscal year. The phases of the program should begin and end where necessary for proper scheduling of physical work. The budgets for this work are reported by fiscal year. Since most well planned projects have the work scheduled by month, it is a simple task to report it by fiscal year.

Q5: All of my other NASA projects have recently gone through a lot of painful rescheduling so that they are budgeted by calendar years. I wonder if the UnESS FY instruction is a bit out of date and we should be using calendar years?

A5: The UnESS instruction is not out of date; it was chosen specifically because the PI knows better than the NASA Program Office what the required funding flows are. If the PI provided cost data by calendar year, NASA would need to allocate funding as NASA thought best, not as the Project really needed it.

Q6: As a University, our NASA contracts have always been fixed price type. Auditors advised us that contracts such as cost-plus-fixed-fee were not allowed by the regulations. This time we are teaming up with two private companies and a federal R&D outfit. There is some concern about the type of contract that will be awarded. Can you discuss this?

A6: A draft contract, similar to the one that will be used for UnESS Missions, can be viewed at the ESSP library website: <http://essp.gsfc.nasa.gov/essplib/>. Look under 'ESSP PROJECT DOCUMENTATION:' and click on the 'Generic Contract Terms and Conditions for ESSP Missions (Educational Institution)' link to view the generic contract.

Q7: Has any thought been given to adding funding to the Concept Study grants to cover the costs of preparing for and attending the site visit?

A7: There are no plans to increase the Concept Study grant to provide additional funding for Downselect Site Visits.

Q8: Will the project's received money up front (at the beginning of Phase 2)?

A8: Yes, through Phase 2, you may receive up to 25% of the total mission funding.

Q9: Can a university give a small business a startup funding, (say 10%) to get them started?

A9:

Q10: What type of contract will we have with NASA? Fixed? Cost-plus?

A10:

Q11: What type of contract can we have with our developer? Fixed plus economic price adjustments (to cover wage increases over 5 years)?

A11:

## **Site Visit Questions**

Q1: Is there currently a schedule or time frame for the site visit?

A1: Yes, site visits will occur during the time period of March 7 to March 23, 2001.

Q2: When will the site visit be?

A2: UnESS site visit information can be found on the UnESS website. Follow the link '[UnESS Downselect Schedule](#)' on the home page.

Q3: What is the agenda for the Site visit presentation?

A3: A sample agenda for the site visit can be found on the UnESS website. Follow the link '[UnESS Site Visit Information](#)' on the home page.

Q4: Will oral presentations be given during the Site Visit?

A4: Yes, but tailor your presentations to fit within the time frame allowed for the site visit. The Downselect team will also be looking at your facilities and asking questions, so time management of your visit will be very important.

Q5: Does the site visit constitute the entire review process for UnESS? Some of the documentation suggests there will be a review meeting at another

location as well. Is the site review the main opportunity for our team to interact with the review team?

A5: Each team's Concept Study Report will be evaluated by the UnESS Evaluation Executive Committee after receipt. Evaluation Plans in the AO indicated that a Kickoff Meeting for the Downselect would be held in Washington D.C.; however, because of request from the PI's and input from various NASA Review Panels, the Kickoff Meeting (Site Visit) will be held at the PI sites. The purpose of the site visit is to allow for the science, engineering and student team to present the concept of their mission directly to the evaluation team, and to provide answers to any questions that the evaluation team might have. Those question(s) thought to be significant will be submitted to the Concept Study Teams three days prior to the scheduled site visit. The site visit will be the only opportunity for the Concept Study team to interact with the evaluation team. After all the site visits, evaluation reports will be submitted to the NASA Associate Administrator for the Office of Earth Science, culminating in the selections for flight pending passage of the Mission Confirmation Review.

## International Space Station Questions

There are still many TBD's concerning ISS use, so please bear with us as we will post updated information as it becomes available. EXPRESS Pallet documentation will not be updated until after the EXPRESS Pallet PDR. Please review the ISS Documents, located at the UnESS website under '[International Space Station \(password required\)](#)', that pertain to your payload. The following ISS documents should be read to better understand the process of placing a payload on the ISS:

### EXPRESS PALLET PAYLOADS

- (1) **SSP 52000-PAH-EPP** INTERNATIONAL SPACE STATION PAYLOADS ACCOMMODATIONS HANDBOOK/EXPEDITE THE PROCESSING OF EXPERIMENTS TO SPACE STATION (EXPRESS) PALLET PAYLOADS
- (2) **SSP 52000-PVP-EPP** Generic Payload Verification Plan EXpedite the PRocessing of Experiments to Space Station (EXPRESS) Pallet Payloads
- (3) **SSP 52000-IDD-EPP** EXpedite the PRocessing of Experiments to Space Station (EXPRESS) Pallet Payloads Interface Definition Document

### WOLF PAYLOADS

- (1) **SSP 52000-PIH-WRP** WOLF Rack Payload Integration Handbook Volumes

They contain most of the information you will need to fly on the ISS. When asking additional questions, please provide as much background information (i.e. document reference numbers, section numbers) as possible so we may get you accurate answers to your questions. If you encounter discrepancies between various documents, please let us know so we can get the discrepancies resolved.

Q1: How should I pick a Launch Date for ISS/Space Shuttle?

A1: UnESS recognizes that vehicle launch dates can and will slip. Choose a launch readiness date that fits your mission and reference it (month/year) in your study. Don't worry if the date changes after you submit your study. After selection, the UnESS project will work with each project to update contingency based on the changing launch date.

Q2: During the Q & A teleconference on October 13th, a new set of launch dates was presented (Sept '04, Feb '05, and June '05). Has there been a UnESS program level decision regarding these dates that should be reflected in our study reports?

A2: See Q&A 1.

Q3: How frequent will data dropouts be?

Q4: What about data latency?

Q5: How big a TCP/IP stack do we need to plan for?

A3-5: The proposed design for the high data rate interface for the Express Pallet uses a Payload Ethernet Hub Gateway (PEHG). This gateway is required to support a throughput of at least 6 Mbps (section 3.5.6.2.1.1 of the ExPCA Technical Specification 6149-EP0001-01). This bandwidth is shared by all Express pallet users. Flow control is not used in the Express Pallet PEHG; instead the Express Pallet PDR material recommends "some active control of contention and use of gateway matched to current gateway output rate is a better mechanism then allowing uncontrolled babbling by payloads at the gateway. Flow control is then not needed and buffer full will not occur." In other words, the use of the HRDL will have to be scheduled to some extent and this scheduling should reduce the probability of data drop out.

The latency through the PEHG is 21 bit times (2.1 microseconds) (Section 3.3.1, SSP 52050).

More information on the HRDL is available in section 3.5.6 of the ExPCA Technical Specification 6149-EP0001-01. The most relevant section is:

#### **3.5.6.2.1.2.1 Gateway and Buffering**

The gateway function shall [1] provide a simple forwarding capability for incoming ISO/IEC 8802-3 packets with a specific destination address.

The gateway function shall [2] check the destination addresses of all incoming ISO/IEC 8802-3 packets. The gateway's ISO/IEC 8802-3 address shall [3] be a downloadable parameter received via the subsystem's MIL-STD- 1553 interface. The gateway function shall [4] ignore packets with all other ISO/IEC 8802-3 destination addresses. The gateway function shall [5] ignore all incoming ISO/IEC 8802-3 broadcasts.

When the gateway function identifies an ISO/IEC 8802-3 packet addressed to it, the following functions will be performed:

- a. The gateway function shall [6] remove the ISO/IEC 8802-3 packet overhead. No specific user data format or size is assumed, and the unwrapped user data will be referred to as a user packet.
- b. It is the responsibility of each payload user to format bit stream data per Consultative Committee for Space Data Systems (CCSDS) source packet format as specified in the Space Data System Standards: Advanced Orbiting Systems, Network and Data Links. The gateway function does not enforce or add any formatting to the user packet CCSDS format is neither verified nor enforced nor added. As no validation is performed, there can be no validation information returned to the sender as a result of processing by the hub subsystem.
- c. The gateway function will latch each unwrapped user packet, in the order received, into a TAXI encoding chip for transmission over the optical HRDL.
- d. If the gateway is enabled by command but no gateway address has been specified then no messages will be forwarded.
- e. The hub subsystem is not a High Rate Frame Multiplexor (HRFM) system.

When an incoming accepted ISO/IEC 8802-3 packet encounters a buffer full condition:

- a. The gateway function shall [7] discard that entire packet and increment the discarded packet counter by one.
- b. The gateway function shall [8] transmit a legal ISO/IEC 8802-3 message. The Source of this message is the Gateway address, and the Destination is the Source of the transmission that caused the overflow. The data portion of this ISO/IEC 8802-3 packet will consist of the first 6 bytes of the transmitted data packet, for example, the CCSDS header information. This broadcast will be enabled or disabled via the MIL-STD-1553 interface.

The only buffer full condition subject to this buffer full detection and notification is the buffer directly supplying user packet data to the TAXI for optical transmission. The main reason for a buffer full condition occurring is that the TAXI transmission rate is set lower than the incoming user packet data rate.

The subsystem shall [9] broadcast the original incoming ISO/IEC 8802-3 packet to all active ports like a normal packet, regardless of its destination address. It is assumed that no user devices will have an ISO/IEC 8802-3 address identical to the gateway address.

The gateway's output data rate shall [10] be determined from a downloadable parameter, received via the MIL-STD-1553 interface on the payload bus, that ranges in value from 0.5 Mbps to 10 Mbps in increments of 0.5 Mbps.

The gateway function shall [11] provide at least 64 kbytes of buffering for incoming user data exclusive of ISO/IEC 8802-3 or subsystem supplied overhead.

#### **3.5.6.2.1.2.2 Unused Hub Subsystem Feature - Flow Control**

The hub subsystem has the capability of transmitting flow control packets in response to gateway-addressed packet. This feature is not used in the ExPCA.

Two additional pieces of information should be made clear to all users.

(1) The HRDL connection to the HCOR and HRFM is going to be a very limited and very scheduled resource. At best, we will probably get 1 HRDL for all truss sites. This means a duty cycle of 25% or less. (2) Ku-band communications down link will only be available around 45% to 55% of the time depending on assembly stage. As a result external payloads should plan on most of their data going into the communication outage recorder and being downlinked later (1 or 2 orbits later).

Then there is the whole question of the operations concepts of the other payloads on the same Ethernet. The suggestions made in the PHEG constraints may not be compatible with the basic CPU and networking power of some payloads. In particular, a couple of payloads do not have the CPU power to burst data. Thus, in order to get their data down, they will have to be in "trickle" mode anytime the HRDL is available. How well one can get several payloads to trickle data at a rate that does not fill the buffer is probably an open question.

Q6: Will station GPS data be available on the station Bus, either 1553, or Ethernet?

A6: ISS orbital position is available on the 1553 bus as part of the broadcast ancillary data. It is updated once per second. The broadcast ancillary

data is described in section 3.3.2.2.3 in SSP 41175-02, Software Interface Control Document, Station Management And Control To International Space Station Book 2, General Software Interface Requirements. A detailed list of the ancillary parameters is in appendix A of this document. A more general overview is provided on the Station GNC via a paper titled "Space Station GN&C for Payloads". This paper is at the UnESS website under 'General ISS Documents'. Please read the caveats associated with it.

Q7: When we are writing an ICD, what data should the team respond to?

A7: The latest version of the JSC/ISS documents. These will be made available through the UnESS website and updated as they become available. When answering a particular issue, reference the title, version, and revision # on the document, so that reviewers can see the information you used.

Q8: How does one access the ISS documents online?

A8: The JSC/ISS documents will be made available through the UnESS website and updated as they become available.

Directions for accessing the ISS documents from the UnESS homepage:

- 1) Go to <http://www.wff.nasa.gov/~code850/pages/uness.html>  
(OR <http://www.wff.nasa.gov/uness/>)
- 2) Click on the "International Space Station" link, under NASA's UnESS Project/Concept Study Documentation
- 3) When prompted, enter:      username:  
  password:  
*If you do not have the username and password, contact the UCPO at Wallops to obtain them.*

The ISS documents on the ISS websites may only be accessed through a government computer. The JSC ISS payload library is located on the web at: [http://issa-www.jsc.nasa.gov/ss/issapt/cmr\\_home.html](http://issa-www.jsc.nasa.gov/ss/issapt/cmr_home.html)

This gets you to the home page that includes a search engine and the baselined document library. The URL for the baselined document library is: <http://iss-www.jsc.nasa.gov/cgi-bin/dsdl+?-h+docnbsln+Program+N>

Q9: How flat will the adapter plate be?

A9: We are looking into this and will provide the information as soon as we receive it.

Q10: ISS has lots of documents about SR&QA level of criticality, for instance, criticality levels of payloads (failure modes). Where can I find information on experiment requirements for residing on the ISS? (i.e. sharp edge, flatness, pointing requirements)

A10: The ISS documents provided on the UnESS website should answer any questions on criticality levels. In particular, look through the Payload Verification Plans. Also, see ISS safety document NSTS 1700.7B and NSTS 1700.7B – ISS Addendum. If questions remain, please ask again for specific information.

Q11: Will a mock-up of the pallet be available for environmental testing?

A11: TBD, but highly unlikely.

Q12: Has the lumped mass model for ISS been completed?

A12: If by "lumped mass model" you mean an integrated ISS configuration at the time of an Express Pallet installation, data is available on-line at:

<http://seat1.jsc.nasa.gov/semda/doks/aseqdac8.html>

However, this data is based on the Rev E Assembly Sequence, which is now out of date. As the Assembly Sequence continues to change, the mass model will change accordingly.

Q13: Is the suitcase simulator still planned for use with Trek and Express payloads?

A13: The STEP-EP is planned for express pallet payloads. The schedule for the STEP-EP is somewhat uncertain due to the overall uncertainty in the Express Pallet schedule. Current plans would have the first STEP –EP delivered in November 2003, with 10 more delivered at a rate of approximately one per month. See more detailed information on the STEP/EP under the "ISS Express Pallet Documents" section of the "International Space Station" link (under Concept Study Documentation) at the UnESS home page. This area is password protected.  
If so what is its:

- Data display functionality
- Command and control functionality

The STEP-EP will have limited functionality for displays and command and control. It will support user-supplied extensions to perform these functions.

- Availability of data from the test equipment (i.e. at what points in the interface is data available)

Data will be available at all of the interfaces – 1553, Ethernet, and analogs/discretes.

- Hardware availability i.e. Period for which simulator is available

There will be 11 STEP-EPs shared by all of the users. The current concept is to provide a STEP-EP for interface testing for one month at about L-18 months and then again for 1 month at L-12 for testing with the instrument integrated with the payload adapter.

- Is it a complete "plug and play" test system in the sense that you can hook a trek system directly to it and simulate the complete (apparent) system - absent the ISS downlink and decommutation at MSFC?

Probably. The TReK and the rack suitcase simulator can be used to simulate the end-to-end system for rack payloads, and the STEP-EP is based on the rack suitcase simulator design.

Q14: Any discussion of your thoughts on the availability and functionality of the software developed by Langley would also be appreciated.

A14: According to Miles Riley at LaRC, they are not thrilled with the STEP-EP because it does not verify the interfaces (see page 4 of Tom Lynch's presentation package on what the STEP-EP does not provide). The STEP-EP would verify that you implemented the 1553 interface enough to talk to the STEP-EP, but would not guarantee that you had met all of the electrical requirements such as rise and fall times. In addition, the STEP-EP does not provide a realistic environment. LaRC is looking at implementing a test tool that simulates other traffic on the 1553 and ethernet interfaces.

The STEP-EP effort is in the formative stages – a draft requirement specification is currently being developed. Note that the answers could change as the system is defined and designed. (Tom Lynch's/MSFC presentation describing the current content for the STEP-EP will be

placed at the UnESS website, [under ISS Express Pallet Documents](#). The draft specification is not yet available.)

Q15: How much thermal input will be allowed into the EXPRESS Pallet?

A15: No more than 50 W per adapter can be transferred to the ExP.

Q16: SSP 52000 IDD-EPP, Appendix C states that MERAT (a thermal model) is available and describes sample cases e.g. nadir pallet, zenith pallet, pallets during reboost etc. etc. However, the model and the corresponding dataset are not in that document.

A16: The appendix referred to was contained in Working Draft #2 of SSP 52000 IDD-EPP and was removed in the Working Draft #3 version. The contents of Appendix C is located at the UnESS website under '[General ISS Documents](#)'. This appendix lists the 90 MERAT thermal cases being run. [The UCPO has this data on disk](#), however the dataset is extremely large. Should you need MERAT information, contact Chuck Williams ([charles.p.williams.1@gsfc.nasa.gov](mailto:charles.p.williams.1@gsfc.nasa.gov)) at 757-824-1435 and he will send you the requested data.

Q17: When will the UF3/UF5/UF6 pallets be available for experiment use?

A17: According to ISS Assembly Sequence Revision F,  
UF3 (nadir pallet) will fly to the ISS in September 2004,  
UF5 (zenith pallet) will fly in February 2005, and  
UF6 (nadir pallet) will fly in June 2005.

Be aware that the pallets could move to other flights or the flight dates could change. [Refer to Question 2, of this section](#), on how to choose a launch readiness date.

The pallets will be at KSC roughly 6-8 months prior to launch. Payloads should arrive approximately 6 months prior to launch. If you need extensive payload unique testing at KSC prior to entering the integration flow, add more time. Refer to Appendix C of the EXPRESS Pallet PAH for deliverable schedules.

Q18: Who will be my interface contact with ISS for the UnESS project?

A18: Betsy Park's office (the Office of Earth Science Research Program Office (RPO)) will be your contact with ISS in support of the UnESS project. A Mission Integration Manager will be assigned to each selected ISS payload to help with all the interfaces.

Q19: Stated accuracy of inertial rates on the ISS are 0.01degs./second per axis at a 0.5Hz bandwidth. Stated knowledge at GPS attach point is <0.46degs

per axis. I would like to know whether there is an ISS structural model that is available that would allow us to integrate the inertial rates to estimate pointing knowledge to better than the current 2 degrees.

A19: This question is being looked into with JSC. In addition, we are attempting to help JSC to find a solution to the general issue of pointing knowledge at the pallet locations. The current approach centers around finding a way to fly a star tracker somewhere on the zenith pallet, cross-correlate it to the nadir pallets, and use ground truth data for each nadir payload to verify internally. Refer to answer for question 21 for additional information.

Q20: What are the limits for ISS excursions?

A20: Maximum excursions are specified to be +/-15 degrees in roll and yaw, and +10 to -20 degrees in pitch with respect to the Local Vertical Local Horizontal (LVLH) attitude. During the periodic reboost of ISS, the station will maneuver 180 degrees in yaw prior to reboost, then maneuver back. Other reboost possibilities are also being considered. The period of time in this alternative attitude will probably be limited to hours. Payloads will not be able to take data during this time in any event, as they will be put on keep alive power. Refer to the paper "Space Station GN&C Overview for Payloads" (reference the ISS GN&C paper, CP458, STAIF, 1999) at the UnESS website for more information.

Q21: Can you provide some discussion of pointing knowledge especially with regard to the potential star tracker on the zenith pallet?

A21: Refer to Question 19 and the [Space Station GN&C Overview for Payloads](#).

Additional comment from Betsy Park (Research Program Manager):

Currently, there is no real information I can provide with regards to star trackers and improved pointing knowledge on the pallets. We are just beginning to investigate the possibility of placing trackers on the zenith pallet and correlating them to positions on the nadir pallets. Each payload would then be responsible for cross-calibrating the data with ground truth measurements. This is only a rough concept at present, and there is a good likelihood that we won't have any more information prior to UnESS selection.

Q22: The pointing knowledge available to the Experimenters using the EXPRESS Pallet is advertised to be between 1 and 2 degrees (reference: International Space Station (ISS) UnESS Research Opportunities). During the UnESS proposal phase, discussions with NASA/JSC EXPRESS

project people indicated that there might be plans to make available a capability for 0.5 degrees pointing knowledge - at the location of the EXPRESS Pallet. We would like to learn more about any plans to improve the pointing knowledge at the EXPRESS Pallet.

A22: [STAIF Paper GNC.pdf](#) and [STAIF Presentation GNC.pdf](#) are two files, a paper and a presentation, that have information on the accuracy available at the attached sites. They are available under the 'ISS General Documents' section of the UnESS website. **These documents are based on ISS Assembly Version 'D', the ISS is now using Assembly version 'F'. Be aware of that fact if you use these documents.**

Please note that the numbers quoted in the paper are usually three sigma not 1 sigma errors. Also, note that these numbers do not include any error associated with the mounting of the EXPRESS Pallet to the Payload Attach Site (PAS) or with mounting an EXPRESS Pallet Adapter to the EXPRESS Pallet. The EXPRESS Pallet System design will need further design and analysis before these will be known. We have had several requests from payload developers and from advisory committees to increase the pointing and attitude knowledge at the attached payload sites. The ISS Program is still working on finding a way to improve this information. There are a couple of zenith looking payloads that are considering adding a star tracker or similar device to determine arc second level pointing information for themselves. How useful such information will be to nadir looking pallet locations is something that we will be able to better determine once the EXPRESS Pallet System design is further along. It will also depend on whether or not the nadir looking payload can help "self-calibrate" at a certain point in time in order to compare their pointing solution to that of a zenith looking payload. Also refer to Questions [6, 19 and 21](#) for additional questions related to ISS pointing accuracy.

Q23: I would like to know whether the ISS team has refined the information in the UnESS research opportunities description. In particular the statement:

"The system will provide a total position error of <3000 feet RSS and an attitude error of <0.46degs. per axis at the GPS antenna site. This position knowledge will degrade with distance to ~1-2 at the S3 truss attach sites."

There is of course a significant difference between <1 deg and of the order of 2 degs. and the ~ symbol means different things to different people. If this statement could be refined in light of your current knowledge I would find it very helpful.

A23:

Q24: Will ISS pointing information be available?

A24: Yes, reference [‘Space Station GN&C Overview for Payloads’](#) at the UnESS website.

Q25: What is the plan for pointing on WOLF?

A25: A star tracker tied to the WOLF is not feasible. We are working on a more complete answer with JSC.

Q26: What are the WOLF flight opportunities?

A26: The first flight opportunities are 12 A.1 (February 2003) and 13 A.1 (June 2003) using the SpaceHab. WOLF payloads may launch in Middeck lockers, the Multi-Purpose Logistics Module (MPLM), or in SpaceHab.

Q27: Any 2004 WOLF flight opportunities?

A27: Unpowered Middeck lockers should be available on most flights in this timeframe. An MPLM is also currently planned for UF3 in September 2004. The next MPLM is on UF5 in February 2005. There are no SpaceHab flights currently planned for 2004.

Q28: How feasible is data storage on magnetic tapes, and what about the return period of data tapes (for WOLF payloads)?

A28: Data tape retrieval is very feasible on the return flights of STS. The projected frequency of Shuttle flights to ISS is approximately every 3 months. This method of data storage and retrieval is being used by other payloads on ISS as well. The MER form and subsequently the payload Integration Agreement would need to note this requirement and request periodic up and down mass for replacing and retrieving tapes.

Q29: When riding to ISS on the STS, will my payload have to meet additional environmental requirements (WOLF only)?

A29: Yes, your payload will have to meet environmental requirements of the carrier system (i.e. Spacehab, MPLM) used to transport your experiment to the ISS.

Q30: What are the opportunities to fly in the Middeck lockers?

A30: Unpowered Middeck lockers offer the most feasibility in manifesting pressurized payloads, particularly farther out in the assembly sequence. They should be available on almost any flight depending on the numbers that are needed. Powered Middeck lockers are for the most part already manifested.

Q31: How often will power to the pallet be interrupted?

A31: Expect power to be interrupted during external vehicle docking and undocking from the station. Contingency operations will also cause an interruption in power. Keep alive power will be provided to payloads during power interruptions for all cases except the most severe contingencies. The power operations scenario has not been developed yet, so the frequency of interruptions is still unavailable. Our current best guess is an 80% power duty cycle.

Q32: How will my experiment electrically connect to the pallet?

A32: This information is provided in the ['ISS Express Pallet Documentation'](#) area at the UnESS website.

Q33: ISS Physical connections to the ISS Ethernet?

A33: It is possible to have 2 connections to the ISS Ethernet on the pallet, with A & B sides on each pallet adapter site.

Q34: How often will return to Earth flights from ISS be?

A34: There are two options for change out of payloads. The first option is the return to earth of an entire pallet, with payloads attached. This is not anticipated to occur on any regular basis. The ExPS would be robotically removed from the truss and reinstalled in the Orbiter for return to earth. The second option is for change out of individual ExPA mounted payloads. The ExPS accommodates on-orbit installation, removal, and change out of ExPA mounted payloads, using ISS standard logistics and EVR capability. Transportation of individual ExPAs to/from the ISS will be via the ULC, a cross bay carrier, or sidewall carrier.

The plan for post assembly complete flights has been one unpressurized and four pressurized flights per year. We anticipate that this will change to add mixed cargo (both pressurized and unpressurized payloads, etc. on a single flight) flights. Detailed flight plans have not been developed for post assembly complete. My best guess is 2 opportunities per year for Pallet and MPLM or SpaceHab payloads and 3 opportunities per year for Middeck locker payloads.

Q35: When does my payload have to be at KSC for payload integration?

A35: Approximately 6 months before the scheduled launch. Refer to Appendix C of the EXPRESS Pallet PAH and Volume V or the WOLF PIH for generic schedule templates.

Q36: When will my payload be loaded into the Shuttle Cargo Bay?

A36: EXPRESS Pallet payload turnover to KSC is approximately 3.5 months before scheduled launch. Turnover of WOLF payloads will depend on the hardware used (MPLM, Middeck locker, Spacehab). Use the references cited in the previous question. Pallet experiment will be integrated onto the pallet, and then loaded into the Orbiter when the Orbiter is on the launch pad (Orbiter in vertical position).  
The RPO is working on developing a distilled, user-friendly version of the pallet payload deliverable templates.

Q37: When will microgravity disturbance information be available?

A37: The microgravity team is in the process of developing the requirements for attached payloads. We are hoping to see data that we can pass along by the end of this calendar year. This data will only apply to the integrated pallet, however. The pallet project will still need to translate the requirements to the pallet/adaptor interface.

Q38: Section 3.1.3.2.6 (Page 48 of SSP57003) shows that Microgravity is TBD. There are no microgravity specs in the Express Pallet documents.

A38: Refer to Question 37 above.

Q39: I would like to be able to contact, or be provided with the appropriate documentation for checking on the microgravity impact of our payload and whether any significant vibration isolation efforts will be necessary to mitigate impacts on the ISS' microgravity environment.

A39: Contact:

Fred Henderson, Boeing 281-336-4256

or

April Steelman 281-853-1606

For more information on microgravity issues.

Q40: The radiation environment specs are apparently contained in SSP52000-PAH-EPP, which I have not been able to locate in an electronic form.

A40: They are now available at the UnESS website under 'ISS Express Pallet Documents'.

Q41: Plasma specs are in SSP30425 section 5.0 and SSP30420, section 3.3 and UV dosage is in SSP30425, Para 7.2. Data interface definitions are specified for MRDL in SSP57002 A-10. If you could find electronic, or hard copies, of these documents, or get them from Betsy I believe that would be helpful.

A41: They are now available at the UnESS website under 'General ISS Documents'.

Q42: Section 4.11.4 of the SSP 52000-PAH-EPP indicates that a FOV model has been developed. From whom/where can this be obtained?

A42: A FOV model has been developed by MSFC. Running the model requires a software package called Satellite Toolkit by Analytical Graphics. Information on the software can be found on the web at <http://www.stk.com>. The MSFC point of contact for the FOV model itself is Don Gerkin at 256-961-1282. The RPO has supported FOV inquiries with our own models in the past. Due to the lack of available workforce at this time, we're unable to support FOV work until later in the spring.